NED University of Engineering & Technology, Karachi

M.Engg. (Mechanical Engineering), Final Examination Fall 2022

MC-541: Digital Image Processing & Machine Vision

Date: 08-02-2023 Max. Marks: 60

Time: 3 Hours

Instructions:

- *Attempt all questions.*
- Q1 *carries* **20** *marks. All other questions carry 10 marks each.*

Q1: Mark as True or False:(*give brief reason/justification/pictorial example where necessary*) (20.0)

i. With OPENING operation in morphology, an object A is likely to be merged/combined with another object B of interest.
ii. Region segmentation is same as boundary extraction.
iii. Object verification is a 1:N matching process; where N is the number of object classes.
iv. Smoothing suppresses the noise and enhance the edges.
v. For active contour model based segmentation, the speed of convergence does not depend on initial assumption.
vi. Quadtree decomposition reveals information about the structure of the image.
vii. The scene point location (coordinates) of a machine vision system with image plane located at (4,3), focal length= 10 cm and object depth of 5 cm is (9,8).
viii. Chain code is orientation independent.
ix. Principal point is not an intrinsic camera parameter (True/False).
x. Non-rigid objects such as fire pixels in an image are not deformable.
xi. Depth discontinuity may cause intensity change.
xii. Thresholding is also known as active contour technique.
xiii. Morphology is an intermediate operation between low level and high level of image processing.
xiv. Marr's vision paradigm is only relevant to stereo correspondence problem.
xv. Lines labelled as '+' in wire-frame representation show a CONVEX edges.
xvi. Circularity feature of 1.0 shows a perfect circular object.
xvii. Larger mask/filter size decreases noise with increased localization of pixel values.
xviii. Intensity is not a uniformity/similarity feature.
xix. Clutter means obscuring object with non-object features.
xx. Phantom point does not exist for 3-D object perception.

Q2.

a. Write the Run Length Encoding (RLE) sequence for the image showin in Fig.1, mentioning the location and value of pixel at the location. (3.0)

b. Write the PROJECTION VECTORS (both horizontal and vertical) of the Fig.1 shown.
You may assume BLACK: 1 and WHITE: 0 (2.0)

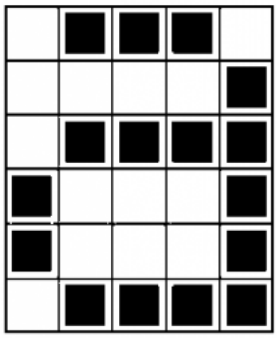

Figure 1

c. Write the QUADTREE Decomposition for the image patch shown in Fig. 2 (3.0)
Note: 1,2,3,4 show the lables of quad-regions, not the pixel values.

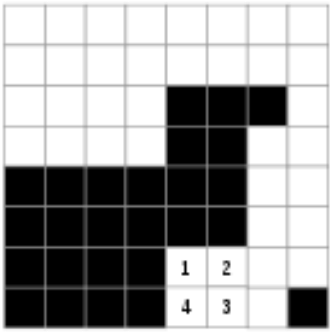

Figure 2

d. 'Quadtree representation/decomposition is mid level image/vision processing phenomenon.' Justify the statement. (2.0)

Q3.

a) With regard to Fig. 3, explain the following: (2.0)
   a. Phantom points
   b. Stereo correspondence problem

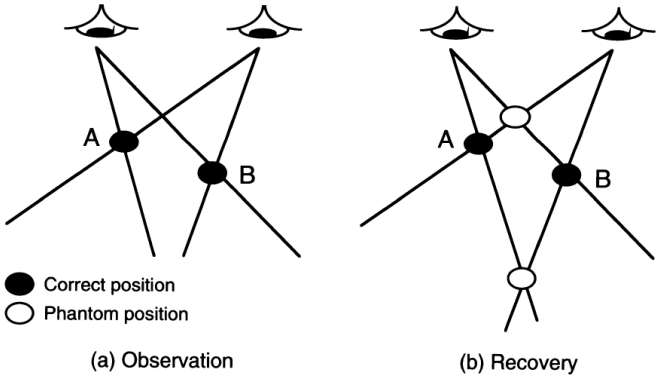

Figure 3

b) With regard to Figure 4, briefly explain Marr's vision paradigm: (3.0)

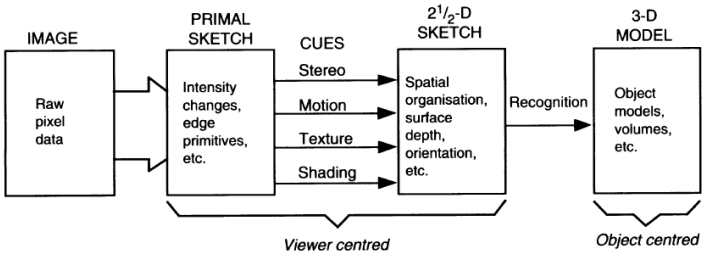

Figure 4

What exactly do we mean by 2½ D vision?

c) Name the the most suitable form of 3-D surface representation of shapes shown in Figure 5(a) and 5(b)? (2.0)

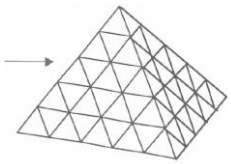

Fig 5(a)

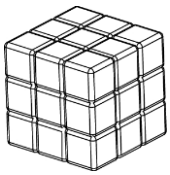

Fig 5(b)

d) For the stereo image problem shown in Fig. 6, explain all variables present in the scene/object, image, world coordinate and camera coordinate system. What is the significance of calculating disparity? (3.0)

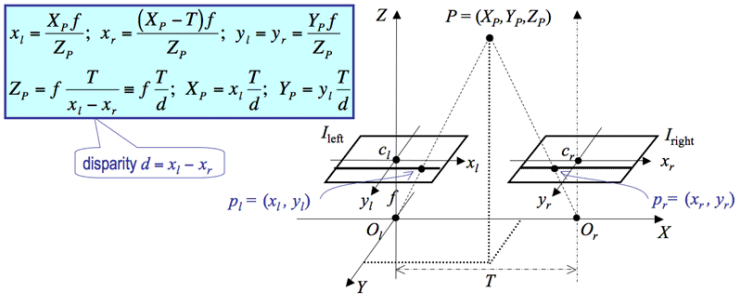

Figure 6

OR

Enlist the intrinsic and extrinsic camera parameters. Why camera and world coordinate system has to be linked with image coordinate system as shown in Fig.7.

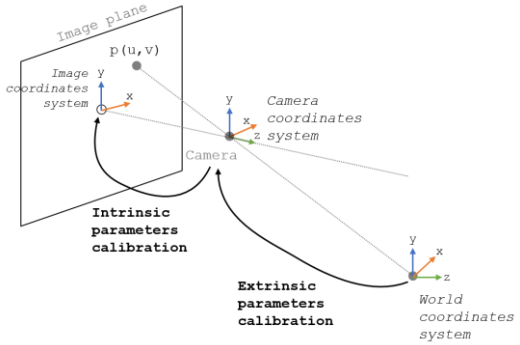

Figure 7

Q4.

a) Write down the mathematical expressions for Erosion, Dilation, Opening, Closing and Boundary Extraction morphological operations. (2.5)

b) What is the difference between intra-class and inter-class variation of features. Explain with an example. (1.5)

c) Apply the five (5) of operations mentioned in 4(a) above, on the given source image shown in Fig. 8 (a) with the given structuring element in Fig. 8 (b) and show the output image in five cases: (6.0)

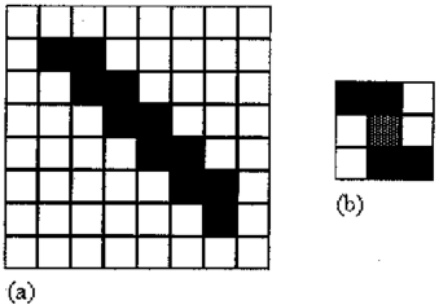

Figure 8

Q5.

a) Write the Chain Code and find the perimeter of the image patch shown in Fig. 9. (3.0)
Starting point is marked as 'S'.

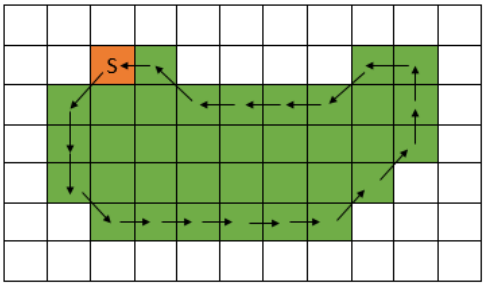

Figure 9

b) Calculate the approximate area of the image blob shown in Fig. 9 with each pixel is scaled as 1 inch by 1 inch. (2.0)

c) Will the area increase or decrease if the pixel is located at centre of the each square? (1.0)

d) Calculate the Euler Number of the text shown below: (1.0)

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e) Identify the purpose of at least 3 fudicial marks in the given QR code. (1.0)

f) Optical flow phenomenon occurs in moving object(s) within a scene. Explain the statement. (2.0).

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